MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

BMP2014 – MATHEMATICAL PROGRAMMING

(All sections / Groups)

21 OCTOBER 2019
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **FOUR (4)** printed pages including Cover Page.
2. Answer **ALL FOUR (4)** questions.
3. Write your answers in the answer booklet provided.
4. All necessary workings **MUST** be shown.

Question 1 (25 marks)

Adwel Adding Machines manufactures three different types of handheld calculators. There are scientific, business and graphing according to their calculating capabilities. The production requirements for these three types' calculators are given in the following table.

	Scientific	*Business*	*Graphing*
Electronic circuit components	5	7	10
Assembly time (hours)	1	3	4
Cases	1	1	1

The company has a monthly limit of 90,000 circuit components, 30,000 hours of labor and 9,000 cases. If the profit is RM6 for each scientific, RM13 for each business and RM20 for each graphing calculator, how many of each should be produced to yield the maximum profit? What is the maximum profit? Formulate a linear programming model and then use an appropriate method to solve the problem.

[25 marks]

Question 2 (25 marks)

a) Graphically solve the following linear programming problem:

$$\begin{aligned} &\textit{Maximize} && Z = 5x_1 - x_2 \\ &\textit{Subject to}: \\ & && 2x_1 + 3x_2 \geq 12 \\ & && x_1 - 3x_2 \geq 0 \\ & && x_1, x_2 \geq 0 \end{aligned}$$

[5 marks]

b) Use the Big M Method to find the optimal solution of the following LP problem:

$$\begin{aligned} &\textit{Minimize} && Z = 4x_1 + x_2 \\ &\textbf{Subject to}: \\ & && 3x_1 + x_2 = 3 \\ & && 4x_1 + 3x_2 \geq 6 \\ & && x_1 + 2x_2 \leq 4 \\ & && x_1, x_2 \geq 0 \end{aligned}$$

[20 marks]

Continued...

Question 3 (25 Marks)

a) Use simplex method to find the optimal solution for the following LP:

$$\begin{aligned} \text{Maximize} \quad & P = 3x + 2y \\ \text{Subject to} \quad & x - 10y \le 10 \\ & -x + y \le 40 \\ & x \ge 0, \ y \ge 0 \end{aligned}$$

[5 marks]

b) Consider the NLP:

$$\text{Minimize } f(x_1, x_2, x_3) = x_1^2 + x_2^2 + 4x_3^2 + x_1x_2 + 3x_1x_3 - 4x_1 - 5x_2$$

(i) Show that f is a convex function. **[14 marks]**

(ii) Find the exact optimal solution. **[6 marks]**

Question 4 (25 Marks)

a) The following table contains the transportation cost per unit from each of the factories to each of the banks, the demand by each bank and the available supplies from each factory.

Factory	Bank A	Bank B	Bank C	Supply
Factory 1	RM 10	RM 16	RM 19	**120**
Factory 2	RM 12	RM 14	RM 13	**200**
Factory 3	RM 18	RM 12	RM 12	**160**
Demand	**140**	**160**	**180**	

Find the initial solution to the transportation problem above using Vogel's method.

[8 marks]

Continued...

b) Use the Northwest Corner Method to find the basic feasible solutions to the transportation problem below.

20	11	3	6	5
5	9	10	2	10
18	7	4	1	15
3	3	12	12	

[5 marks]

c) A taxi hire company has one taxi at each of five depots *a*, *b*, *c*, *d* and *e*. The customer requires a taxi in each town, namely, *A*, *B*, *C*, *D* and *E*. Distances (in kilometers) between depots (origins) and towns (destinations) are given in the following distance matrix.

	a	*b*	*c*	*d*	*e*
A	140	110	155	170	180
B	115	100	110	140	155
C	120	90	135	150	165
D	30	30	60	60	90
E	35	15	50	60	85

Use Hungarian Method to determine the number of taxis that should be assigned to customers while keeping the distance travelled to a minimum.

[12 marks]

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